

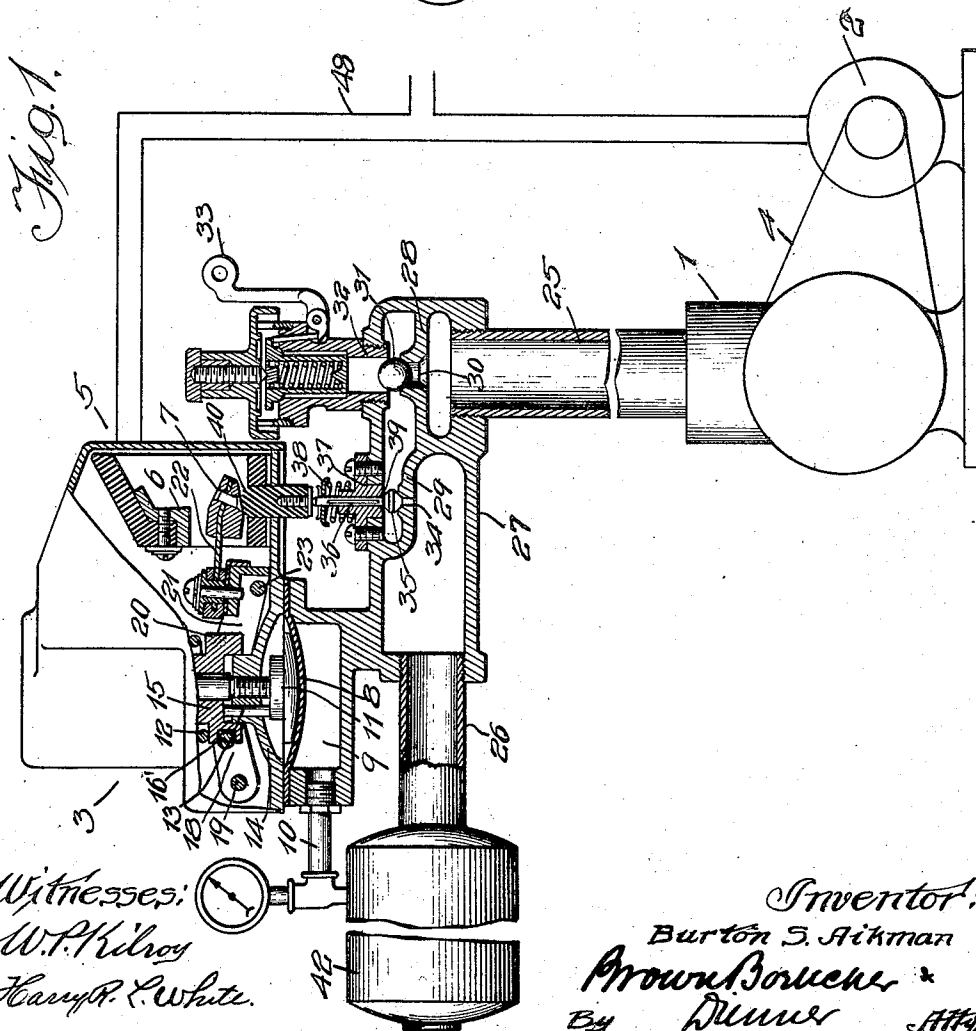
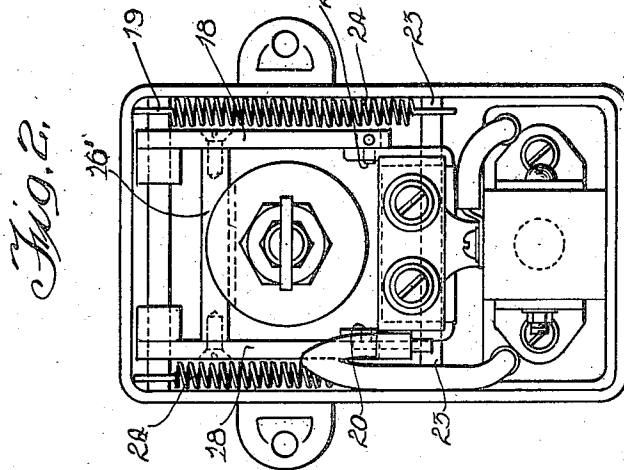
June 3, 1924.

1,496,510

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UNLOADER AND CUT-OFF VALVE

Filed March 30, 1921



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UNITED STATES PATENT OFFICE.

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UNLOADER AND CUT-OFF VALVE.

Application filed March 30, 1921. Serial No. 456,843.

To all whom it may concern:

Be it known that I, BURTON S. AIKMAN, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Unloaders and Cut-Off Valves, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to air compressors, and more particularly it provides means for unloading the compressor upon starting, and for cutting off the connection between the storage tank and the compressor so that leakage of air will be prevented.

I have observed that in air compressors where the air is stored in a storage tank which is periodically depleted, the starting of the compressor is, (in the smaller sizes), made difficult by the leakage of air past the check-valve into the discharge pipe of the compressor. On larger installations it is customary to employ a device for holding the intake valve of the compressor away from seat, so that the motor can be brought to speed before the intake valve is permitted to seat, so that the motor has sufficient power to carry the load. In smaller installations, it is the practice to employ merely a check valve between the storage tank and the compressor, and to depend upon the leakage for evacuation of the compressor discharge pipe, so that the compressor may start without load.

If a bleeder port in the discharge pipe of the compressor is provided, there is during compressing of the air a very considerable waste of power due to the leakage of compressed air from said bleeder port. If no bleeder port is provided, the discharge pipe of the compressor will not be properly evacuated. This is due to the fact that a check valve in the discharge line of the compressor will not stay tight very long. Due to the constant pounding of the valve upon its seat, it quickly reaches a point where the valve and the seat do not fit closely, and serious leakage is the result. Various attempts have been made to cure this difficulty, but it appears to be inherent in the use of a check valve that the valve and the seat will pound and destroy the fit between these parts.

It is the primary object of my invention to obviate the necessity for a check valve by

providing a cut-off valve which is actuated when the compressor is stopped to cut off the connection between the compressor and the storage tank. This cut off valve operates both as a stop and waste valve to permit the contents of the discharge pipe between said valve and the compressor to escape to atmosphere, so that the compressor is unloaded until it is again put into operation, even though the periods of time between successive operations of the compressor are very brief.

I combine the pressure control switch which governs the cutting in of the driving motor with this cut off and unloading valve, so that when the pressure in the reservoir has reached a predetermined value, the motor will be stopped, the cut off valve will be closed, and the compressor will be unloaded for the next operation.

In order to acquaint those skilled in the art with the manner of constructing and operating my invention, I will now describe a particular embodiment of the same in connection with the accompanying drawings, in which:

Figure 1 represents, partly in section, and partly diagrammatically, an air compressing system embodying my invention; and,

Figure 2 is a plan view of the governor or controller.

The system illustrated includes the compressor 1, the storage tank 42 and the control device 3. The compressor 1 is driven by an electric motor 2, to which it is suitably belted, or otherwise connected, as indicated at 4. The circuit of the motor 2 is controlled by a pressure controlled switch 5, which may be of a character heretofore known, or of any desired construction. The particular controller switch which I have illustrated is known in the art as a type "CD-3" governor. This governor is modified in order to operate the cut off and unloading valve, as will be described later. The governor 5 comprises a stationary contact 6, and a movable contact 7, which are connected in the circuit 48 of the motor 2.

The movable contact 7 is controlled by a pressure sensitive element comprising the diaphragm 8, which diaphragm is subjected on its lower side to the pressure in the cylinder 9, this cylinder being in communication with the storage tank 42 through a pipe 10. A movable spring pressed piston 11 rests

upon the top of the diaphragm, this piston being held in its downward position by a spring 12, which tends to oppose the pressure of the compressed air on the lower side of the diaphragm 8. The piston 11 is guided by a series of pins 13, in this case three in number, which are guided in holes in a plate 14 above the diaphragm 8. These pins engage the lower side of a collar 15, which is pressed downwardly by the spring 12 to oppose the movement of the diaphragm 8. The collar 15 has a groove which embraces a cross pin or rod 16 connected in the sides of the levers 18, which levers are pinned upon a common shaft or pivot 19 at the rear of the controller or governor. The forward end of the levers 18 are connected to the short arms 21 at the pivot 20, the short arms 21 bearing a flat spring 22, upon the outer end of which is the contact 7. This contact is connected to one side of the circuit 8. The outer side of the circuit is connected to the stationary contact 6. A pair of springs 24, shown in Figure 2, connect the pins 19 and 23, and tend to cause the arms 18 and 21 which form a toggle mechanism, to collapse on one side or the other as controlled by the upward or downward movement of the collar 15. Upon upward movement of the collar 15, the pin 16 is raised until the contact 7 engages the stationary contact 6, whereupon the toggle will be broken in the opposite direction and the spring 24 will cause the toggle to collapse suddenly, whereupon the contact 7 is separated from the contact 6 with a quick snap action. Upon the reverse operation, namely, lowering of the collar 15, the pivot 20 will be brought below the line of center of the pins 19 and 23 whereupon the springs 24 will lift the contact 7 upwardly, closing it against the contact 6.

The compressor 1 and the tank 42 are connected through pipes 25 and 26, which are separated by a valve body 27. This valve body 27 serving as a suitable support for the controller 5. The valve body 27 contains a passageway therethrough, which is obstructed by the walls 28 and 29, wall 28 having a passageway 30 therethrough, normally obstructed by a ball check valve 31, this check valve 31 being guided in a tubular extension 32 of a pop valve 33, which lies immediately above it. The wall 29 contains a passageway 34, which passageway is controlled by the cut off valve 35. The valve 35 has a stem 36, which is fluted to permit air to pass the same, as will be described more at length later. This stem passes through a cover plate 37, which is clamped over an opening of the side wall of the valve body 27. A spring 38 tends to raise the valve 35 against a seat 39 which is formed in the cover plate

37. A button of insulating material lies above the stem 36 and below the contact 7, in such position that when the contact 7 is lowered, the button 40 will be pressed down and will engage the top of the stem 36, opening the valve 35 away from its seat 39. The air which is then contained in that part of the system defined by the wall 29 and the compressor 1 is rapidly discharged to atmosphere, whereby the compressor is unloaded for the next start. The pop valve 33 is seated over the small check valve 31, in order to form a guide for the same, but it is to be understood that a screw cap might be employed for the same purpose.

The operation of the device is as follows: Assuming that the pressure in the tank 42 is depleted to such an extent that the spring 12 forces the collar 15 downwardly, causing the toggle arms 18 and 21 to throw the contact 7 upwardly against the stationary contact 6: Thereupon, the circuit for the motor 2 will be closed. The spring 38 raises the valve 35 against its seat 39, but pressure from the tank 42 does not enter the discharge pipe 25 of the compressor, because the small check valve 31 prevents retrograde movement of the same. Even if the small valve 31 is not tight against its seat, it will prevent the sudden rush of compressed air back into the discharge pipe 25, and will permit the compressor 1 to be started before it is fully loaded. The pipe 25 between the check valve 3 and compressor 1 has sufficient capacity to permit the compressor to make about a half-dozen strokes before the pressure therein is raised to the minimum tank pressure. This permits the compressor, therefore, to take up its load gradually, and in fact, to start without being overloaded.

As soon as the pressure in the pipe 25 becomes great enough, the check valve 31 will be forced away from its seat with each stroke of the compressor 1, and air will be discharged into the storage tank 42. While the port 34 is relatively small, it does not serve as a restriction of any importance. This is particularly true because of the capacity of pipe 25.

As soon as the tank 42 is charged to the proper pressure, the diaphragm 8 will be forced upwardly, whereupon the toggle arms 18 and 21 will be pressed upwardly, and the spring 24 will spring the contact 7 downwardly, opening the circuit 48, and at the same time moving the valve 35 away from its seat 39, and moving it against its seat over the port 34. This places the discharge pipe 25 and space between the walls 29 and 28 in communication with the atmosphere through the opening about the stem 36. Air is free to move from the discharge pipe 25 past the valve 31, because

the valve 31 opens in that direction, but movement in the opposite direction is prevented, or at least is greatly hindered by the valve 31 tending to seat in the reverse direction.

The cut-off and unloading valve 35 may be formed as two separate valve bodies without departing from my invention. The fundamental requirement is that if the cut-off port is closed, the relief port should be open, and vice versa. It is immaterial whether the check valve is employed in the same valve case, or in a separate case, the fundamental requirement being that the check valve lie on the compressor side of the cut off valve. The relief port may be on either side of the check valve, but it must communicate with the compressor side of the cut-off valve.

The location of pop valve 33 on the compressor side of the cut off valve 35 is important. Quite often when the pop valve is operated either manually or automatically, it will not seat absolutely tight, with the result that leakage occurs. The purpose of a pop valve is to prevent the compressor from raising the pressure of the tank to a dangerous point. In other words, a pop valve is useful only when the compressor is operating, since the pressure is created by the compressor. Consequently, I have disposed the pop valve 33 on the compressor side of the cut off valve, where any leakage of this pop valve will occur only during operation of the compressor. Usually the ratio of time between the running of the compressor and the standing of the tank under pressure is very small. Consequently, a leaky pop valve located in the present situation will cause a minimum of loss. It is obvious that the pop valve may be located anywhere on the compressor side of the cut-off valve 35, but I prefer to place it above the ball check valve 31, so that it may be mounted upon the same base which supports the switch and cut off valve.

I claim:

1. In combination a fluid compressor having the usual valves, a pressure tank charged by the same, a discharge pipe from the compressor to the tank, a pressure controlled cut-off and unloading valve in the discharge pipe between the compressor and the tank and a check valve between said first valve and the compressor for preventing the pressure from the tank from being imposed upon the compressor when the cut-off valve is opened.

2. In combination a compressor having the usual inlet and discharge check valves, a discharge pipe therefor, a hollow valve body having a passageway therethrough connected in said discharge pipe, a pair of walls in said body transverse to said passageway, said walls having ports there-

through, a check valve seated over one of said ports near the compressor and a pressure controlled cut-off poppet valve for obstructing the other port, said valve body having an atmospheric passageway terminating internally in a port, said cut-off valve extending through said passageway and having a valve face for controlling said last named port.

3. In combination a tank, a compressor, a discharge pipe between the tank and the compressor, a stop and waste valve in said pipe, and a check valve also connected in said pipe between said first valve and the compressor the discharge pipe between the compressor and the check valve being adapted to receive the air delivered by several strokes of the compressor before the pressure therein rises to tank pressure.

4. In combination a storage tank, a compressor, a discharge pipe between the tank and the compressor, a stop and waste valve in said pipe, and pressure controlled means subject to the pressure in the tank for operating said stop and waste valve said valve having snap actuating means for opening the valve at a predetermined maximum pressure and for closing the valve at a predetermined minimum pressure.

5. In combination a storage tank, a compressor, a motor for the compressor, a control switch for the motor, a cut-off valve between the compressor and the tank, and a pressure sensitive element for opening the switch and closing the cut-off valve when a predetermined pressure in the tank is reached.

6. In combination a storage tank, a compressor, a motor for the compressor, a control switch for the motor, a connecting pipe between the compressor and tank, a stop and waste valve in said pipe for shutting off the tank from the compressor and for unloading the compressor, and a pressure sensitive element for opening the switch and closing the cut-off valve when a predetermined pressure in the tank is reached.

7. In combination a storage tank, a compressor, a pipe connecting the compressor and the tank, a transverse wall in a portion of said pipe, a port therethrough, a waste port in alignment with said first port, and a double acting poppet valve controlling said first port for cutting off communication between the tank and the compressor, and for controlling said second port to unload the compressor, said poppet valve being actuated upon the attainment of a predetermined pressure in said storage tank.

8. In a valve of the character described, a cut-off port, a waste port, a poppet valve adapted to control said port, a pressure controlled diaphragm, a pair of toggle arms controlled by said diaphragm, and a snap spring for said toggle arms, said toggle

arms controlling the operation of said poppet valve.

9. In combination a compressor, a storage tank, a connection between said compressor and said tank, a pressure actuated cut-off valve in the connection responsive to a predetermined pressure in the tank for closing off the connection between the compressor and the tank, and a pop valve located on the compressor side of said cut-off valve.

10. In combination, a compressor, a storage tank therefor, a discharge pipe for the compressor, a cut-off and unloading valve in the discharge pipe between the compressor and the tank, a check valve between said first valve and the compressor, and means for stopping the compressor when the cut-off valve is operated.

11. In combination, a tank, a compressor, a discharge pipe from the compressor to the tank, a motor, a controller having a pressure-sensitive element adapted to act upon a predetermined maximum pressure and upon a predetermined minimum pressure in the tank to stop and start the motor, and a cut-off valve located in said pipe adjacent the tank, said valve being controlled by said pressure-sensitive element.

12. In combination, a tank, a compressor, a discharge pipe from the compressor to the tank, a motor, a controller having a pressure-sensitive element adjusted to act upon a predetermined maximum pressure and upon a predetermined minimum pressure in the tank to stop and start the motor, a control switch for the motor governed by said element, and a cut-off and unloading valve located in said pipe adjacent the tank, said valve being also controlled by said element.

13. In combination, a tank, a compressor, a discharge pipe from the compressor to the tank, a motor, a controller having a pressure-sensitive element, a cut-off valve located in said pipe adjacent the tank, said valve being controlled by said element, and means actuated together with said cut-off valve for stopping the motor.

14. In combination, a tank, a compressor connected to the tank by a pipe which requires several strokes of the compressor to fill it to predetermined minimum pressure, a check valve and a pressure-controlled cut-off valve located in said pipe adjacent the tank, and a pop valve connected to said pipe between said cut-off valve and the compressor, said check valve lying on the compressor side of the cut-off valve.

15. In a controller and cut-off valve, a pressure-operated diaphragm, a switch arm bearing a movable contact, a stationary contact above said movable contact, a valve-operating stem below said movable contact, and a valve actuated by depression of the stem, said stem being depressed by the

downward movement of said arm to open the contact.

16. A cut-off and check valve comprising a valve casing, a diaphragm chamber mounted on the top of said casing, a pressure-sensitive diaphragm mounted on said diaphragm chamber, a switch adapted to be actuated by said diaphragm, a substantially horizontal wall on the interior of said valve casing, said wall having a port therethrough, a cut-off and unloading valve passing through a wall of the valve casing controlling said port, said valve having a stem adapted to be depressed by said switch when said switch is opened, a second horizontal wall having a valve port therethrough and a check valve covering said valve port.

17. A cut-off and check valve comprising a valve casing, a diaphragm chamber mounted on the top of said casing, a pressure-sensitive diaphragm mounted on said diaphragm chamber, a switch adapted to be actuated by said diaphragm, a substantially horizontal wall on the interior of said valve casing, said wall having a port therethrough, a cut-off and unloading valve passing through a wall of the valve casing controlling said port, said valve having a stem adapted to be depressed by said switch when said switch is opened, a second horizontal wall having a valve port therethrough and a check valve covering said valve port, an opening through the top side of the valve casing substantially in line with said last named valve port and a pop valve having a stem threaded in said opening over said check valve.

18. In combination, a compressor, a tank therefor, an automatically controlled switch for stopping and starting the compressor in accordance with the pressure in the tank, a discharge pipe for the compressor, a cut-off and unloading valve in the discharge between the compressor and the tank, and a check valve between said first valve and the compressor.

19. In combination, a compressor, a storage tank therefor, a discharge pipe for the compressor, a cut-off and unloading valve in the discharge pipe between the compressor and the tank, and a check valve independent of said compressor between the first named valve and the compressor to provide a relatively small storage space at substantially atmospheric pressure when the compressor is started so the compressor need not start under load.

20. In combination, a compressor having the usual inlet and discharge check valves, a storage tank, a pipe connecting said compressor and said tank and including a combined unloading and cut-off valve for the compressor, said valve having a passageway therethrough, a cut-off valve port forming part of the passageway, a check valve port

forming a part of said passageway and lying on the compressor side of the cut-off valve, a check valve for said latter port, a relief port communicating with said passageway on the compressor side of the cut-off valve, and valve means for governing said first and said last port, and pressure controlled means governed by the pressure in the storage tank for operating said cut-off valve.

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In witness whereof, I hereunto subscribe my name this 25th day of March, A. D. 1921.

BURTON S. AIKMAN.